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# Developing a Systems Approach to Arms Control Verification

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# **Developing a Systems Approach to Arms Control Verification**

*2015 INMM/ESARDA Workshop*

*Arms Control Working Group – Systems concept to arms control verification*

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Verification of nuclear arms control agreements has historically focused on monitoring a state's compliance with specific associated declarations. As the quantity of nuclear weapons is reduced, the need for higher confidence drives increasingly intrusive and costly verification measures. At the same time verification must be balanced with a state's need to control access to sensitive information and uphold its Nuclear Non-Proliferation Treaty (NPT) Article 1 or 2 commitments. Developing a systems approach that evaluates the state as a whole could help identify areas where effective verification could provide the greatest confidence that a state is complying with its commitments. This would help inform the most fruitful avenues for future arms reductions or disarmament efforts, assist in the analysis of tradeoffs, and aid the prioritization of evaluation of new approaches and technologies for verification.

One approach towards developing this systems approach has been to explore parallels with the IAEA's State-level concept (SLC) for safeguards. The SLC has recently been advanced as a way to increase the effectiveness and efficiency of safeguards. The SLC sought to address the shortcomings in the traditional approach that focused on verifying the non-diversion of declared nuclear materials at individual nuclear facilities. Instead, by designing a safeguards regime that treats the state as a whole rather than as a collection of unrelated facilities, and by piecing together a broad range of information encompassing declarations, technical monitoring data, and other safeguards-relevant information such as open source, nuclear-related trade, and information from member states' national technical means, it may be possible to provide state-level confidence that commitments are being upheld.

A central component of the SLC is the development of a customized State-level safeguards approach (SLA), which describes the process for planning safeguards activities within a state. The SLA is comprised of three elements:

1. Analyzing plausible acquisition paths
2. Establishing and prioritizing technical objectives
3. Identifying applicable safeguards measures to address the technical objectives.

An acquisition path is the sequence of technical activities a state can use to obtain weapons-usable nuclear material. The APA is based on the IAEA's physical model, which identifies and characterizes all possible components of each stage of the nuclear fuel cycle. Each path represents the material forms traversed and set of processes exploited to obtain the weapons-usable nuclear material. These process steps may involve diversion from declared facilities, misuse of declared facilities, undeclared import of nuclear materials, or the operation of undeclared facilities.

The INMM Nonproliferation and Arms Control (NAC) Technical Division has been co-hosting a series of workshops with the ESARDA Verification Technologies and Methodologies (VTM) Working Group to develop this systems by exploring parallels with the IAEA's State-level concept (SLC) for safeguards. The first workshop was in conjunction with the 2014 Fall Meeting of the ESARDA VTM Working Group in Ispra, Italy. It focused on trying to identify and understand the acquisition pathways and the factors that influence pathway attractiveness. A second meeting was co-hosted by Lawrence Livermore National Laboratory's (LLNL) Center for Global Security Research (CGSR) in July 2015 to focus on identifying and prioritizing verification objectives based on a state's strategic interests and military capabilities.

Key lessons learned are:

1. **Identifying specific verification objectives requires the engagement of multiple communities.** Verification objectives may be treaty-specified or dependent on a state's own security objectives. A path analysis to endpoints that contravene these objectives can then be used to identify the parts of the enterprise where arms control agreements could be most effective. These verification objectives must be collaboratively developed with the political and military leadership and the technical verification community.
2. **Detection goals depend primarily on security factors.** Detection goals, such as timeliness and "significant quantity", depend not just on technical factors but also on a partner state's security concerns and ability of its enterprise to mitigate potential treaty violations.
3. Devising a high-confidence verification regime will likely need the melding of parallel approaches – one based on purely technical monitoring requirements and the second based on national security requirements.

This is not a new concept -- states with significant experience in negotiating and implementing arms control treaties likely already perform most elements of the systems analysis. The primary benefit of a systematic approach may be to better engage a broad range of states, some without the experience or capacity for analyzing verification regimes, and promote understanding about the security and technical challenges associated with arms control verification. Such an analytic tool may help identify enterprise constraints and lead to more creative solutions to future arms control problems. It would be interesting to explore the possible venues and mechanisms that could be used to advance this work.